Effect of Carbon dioxide on structural and functional viability of human saphenous vein endothelium – Role of calcium mobilisation and nitric oxide production

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Abstract

Objective Carbon dioxide (CO2) is used by many endoscopic vein harvesting systems to facilitate visualisation and dissection by creating a subcutaneous tunnel. We aim to investigate the potential detrimental effect of CO2 insufflation, on endothelial structural and functional viability of human saphenous vein (HSV). Method We performed an ex vivo experiment on HSV segments (n = 40) by applying CO2 for 40 minutes at 6 – 12 mmhg in a specially designed chamber and compared it with controls (n = 40). We have investigated the level of endothelial damage by Calcein/Propidium iodide (PI) Live/Dead assay. Functional viability of HSV was assessed by Ca2+ (FLUO3 AM) and nitric oxide (DAF-FM) specific indicators for calcium mobilisation and endothelial nitric oxide synthase related nitric oxide (NO) production. Results CO2 did not cause any immediate structural endothelial damage and there was no statistical difference between control and CO2 groups (Calcein p = 0.27 and PI p = 0.98). After CO2 exposure and bradykinin stimulation, Ca2+ mobilisation was significantly attenuated (p = 0.013) and NO generation was also markedly reduced in endothelial cells, without reaching statistical significance (p = 0.078). Conclusion We believe these results are purely due to CO2 insufflation, which can compromise the entire length of vein graft. However, more research is required to establish, whether these findings are transient in nature or they have long term implications on graft survival and clinical outcome.

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Table 1: Normalised maximum fluorescence intensity (FLUO 3 AM Assay)

	Control Group	CO2 Group	p value
	(n=10)	(n=10)	
Pre Bradykinin (mean \pm SD)	53.54 ± 10.7	41.28 ± 17.85	0.145
Post Bradykinin (mean \pm SD)	64.77 ± 14.9	40.62 ± 16.18	0.013^{*}

 $^{*}\,p = < 0.05$ considered statistically significant

Table 2: Normalised maximum fluorescence intensity (DAF-FM assay)

	Control Group	CO2 Group	p value
	(n=10)	(n=10)	
$\label{eq:pre-Bradykinin} Pre \ Bradykinin \ (mean \pm SD)$	63.6 ± 14.3	57.8 ± 22	0.499
Post Bradykinin (mean ± SD)	73.1 ± 14.0	59.4 ± 18.4	0.078

 $p = < 0.05 \ considered \ statistically \ significant$







FLUO 3 AM Fluorescence Assay







